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## Observations of late instar larva survival of Cotesia (Hymenoptera: Braconidae) parasitoid attack of Euphydryas anicia cloudcrofti (Lepidoptera: Nymphalidae).

Over the course of rearing a population of 100 Euphydryas anicia cloudcrofti (Ferris & Holland, 1980) (Lepidoptera: Nymphalidae) in captivity, an interesting observation emerged of a unique parasitoid-host interaction. The parasitoid infecting this population was identified as belonging to the genus Cotesia (Hymenoptera: Braconidae). Current molecular studies are under way to determine the exact identity of this parasitoid, which may represent a new species of Cotesia.

The first observation of E. a. cloudcrofti larvae attacked by a parasitoid came from three wild collected larvae in October of 2006. These larvae were in the third and fourth instars, and all of these larvae died shortly after the Colesia larvae emerged to pupate. In the following spring, three post-diapause larvae (fifth and sixth instars) were able to survive after the Cotesia larvae emerged to pupate. These surviving larvae became very lethargic and refused to eat for several days, but then seemed to recover. Two of these larva proceeded to pupate, while the third died before pupation. Of the two larvae that immediately pupated, one emerged as a normal adult and the other displayed wing deformities. The same phenomenon was observed again with wild-caught larvae in 2007 (from a total population of 100 larvae), when the early instars died after parasitoid emergence but a single late instar larva survived the parasitoid attack.

Parasitoids are distinguished from parasites by the very fact that they cause the eventual death of the host (Godfray 1993; Borrer et al., 1981; Ricklefs,

1979), but this observation of E. a. cloudcrofti survival, however, along with observations of Arctiid larva (Platyprepia virginalis (Boisduval)) surviving Thelairia bryanti emergence (English-Loeb et al., 1990), may cause us to reconsider the relationship between parasitoids and parasites with their hosts. Perhaps it would be more appropriate to view this relationship as a continuum with at one end pure parasitoids cause certain host death; while at the other pure parasites cause certain host survival; and intermediate points along the continuum represent less certain host survival outcomes.

Although host survival of parasitoid attack may be rare, the fact that it occurs at all in Lepidoptera is biologically significant because it suggests that specific conditions exist that will permit a host to survive a normally fatal parasitoid attack.

Investigations to define conditions that permit host survival would be warranted. In this case the common feature between the E. a. cloudcrofti and P. virginalis observations is that they occurred in captive reared populations. It is possible that some condition of artificial rearing better enables a host to survive parasitoid attacks.

It is also quite possible that this phenomenon occurs at such low frequencies in the wild population that it has gone undetected. Ehrlich and Hanski (2004) noted Cotesia parasitizing checkerspot butterflies often display specialized behaviors that are not characteristic of their congeners. Host survival may be a result of this specialized Cotesia behavior, or it may be the result

of an evolutionary adaptation of *E. a. cloudcrofti* larvae to counter parasitoid attack.

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